

## CLAIMS:

Sub 1  
1. An organic polymer having a plurality of regions along the length of the polymer backbone and comprising two or more of the following:

(i) a first region for transporting negative charge carriers and having a first bandgap defined by a first LUMO level and a first HOMO level; and

(ii) a second region for transporting positive charge carriers and having a second bandgap defined by a second LUMO level and a second HOMO level; and

(iii) a third region for accepting and combining positive and negative charge carriers to generate light and having a third bandgap defined by a third LUMO level and a third HOMO level,

wherein each region comprises one or more monomers and the quantity and arrangement of the monomers in the organic polymer is selected so that the first, second and third bandgaps are distinct from one another in the polymer.

Sub A1  
2. An organic polymer according to any one of the preceding claims, wherein the first region comprises a first monomer comprising a substituted or unsubstituted aromatic or heteroaromatic group.

3. An organic polymer according to claim 2, wherein the first monomer comprises a substituted or unsubstituted fluorene group.

4. An organic polymer according to claim 3, wherein the first monomer comprises a 2,7-linked dialkyl fluorene group.

5. An organic polymer according to claim 4, wherein the 2,7-linked dialkyl fluorene group is a 9,9 dioctyl fluorene group.

Sub A2  
6. An organic polymer according to any one of claims 1 to 5, wherein the second region comprises a second monomer comprising a substituted or unsubstituted aromatic or heteroaromatic group.

7. An organic polymer according to claim 6, wherein the second monomer comprises a triarylamine unit having the general formula  $[Ar_3N]$  wherein each Ar is the same or different and comprises a substituted or unsubstituted aromatic or heteroaromatic group.

Sub A3  
8. An organic polymer according to claim 6 or 7, wherein at least one Ar comprises a substituted or unsubstituted phenyl group.

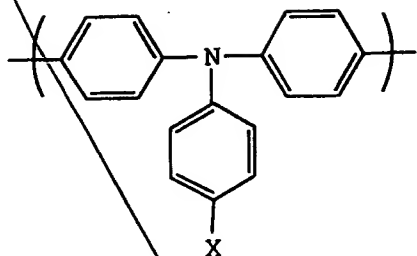
9. An organic polymer according to claim 7 or 8, wherein at least one Ar comprises a substituted or unsubstituted aromatic or heteroaromatic side group that is pendent to the polymer backbone.

10. An organic polymer according to claim 9, wherein the side group comprises a substituted or unsubstituted aryl group.

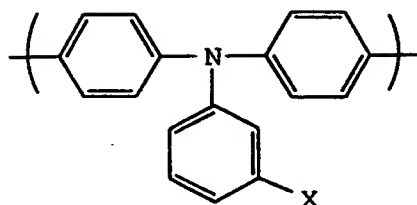
11. An organic polymer according to claim 10, wherein the side group comprises an unsubstituted phenyl or a monosubstituted or 3,5-disubstituted phenyl group.

Sub A4  
12. An organic polymer according to any one of claims 9 to 11 wherein the side group has a substituent group comprising a substituted or unsubstituted alkyl, perfluoroalkyl, alkylaryl, arylalkyl, heteroaryl, aryl, alkoxy, thioalkyl or cyano group.

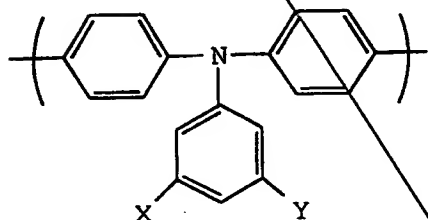
13. An organic polymer according to any one of claims 7 to 12, wherein the triarylamine unit comprises a group having a formula as shown in any one of Formulas I, II, or III:



(I)



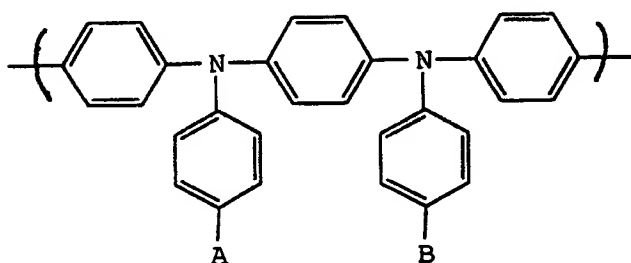
(II)



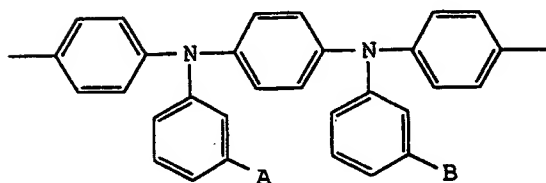
(III)

where X and Y are the same or different and are substituent groups.

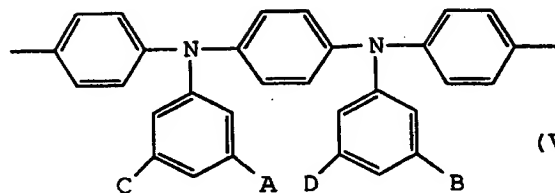
14. An organic polymer according to claim 13, wherein the triarylamine unit comprises a group having a formula as shown in any one of Formulas IV, V or VI:



(IV)



(V)



(VI)

wherein A, B, C and D are the same or different and are substituent groups.

Sub A5 15. An organic polymer according to claim 13 or 14, wherein one or more of X, Y, A, B, C and D is independently selected from the group consisting of hydrogen, alkyl, aryl, perfluoroalkyl, thioalkyl, cyano, alkoxy, heteroaryl, alkylaryl, and arylalkyl groups.

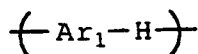
16. An organic polymer according to claim 15, wherein one or more of X, Y, A, B, C and D is independently selected from the group consisting of an unsubstituted, isobutyl group, an n-alkyl, an n-alkoxy or a trifluoromethyl group.

Sub A6 17. An organic polymer according to claim 15 or 16, wherein X and Y or A, B, C and D are the same.

18. An organic polymer according to any one of the preceding claims, wherein the third region comprises a third monomer comprising a substituted or unsubstituted aromatic or heteroaromatic group.

19. An organic polymer according to claim 18, wherein the third monomer comprises a group H which is an aromatic or heteroaromatic diazine group fused to a benzene or thiophene group.

20. An organic polymer according to claim 19, wherein the third monomer comprises a group having a formula as shown in Formula IX:



(IX)

wherein  $Ar_1$  is a substituted or unsubstituted aromatic or heteroaromatic group.

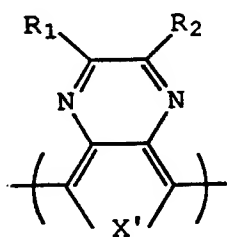
21. An organic polymer according to claim 20, wherein the third monomer comprises a group having a formula as shown in Formula X:



wherein  $Ar_2$  is a substituted or unsubstituted aromatic or heteroaromatic group and  $Ar_1$  is as defined in claim 20.

22. An organic polymer according to claim 20 or 21, wherein  $Ar_1$  or  $Ar_2$  independently comprises a substituted or unsubstituted, fused or unfused benzene, thiophene, furan, quinoxaline, biphenyl or fluorene group.

23. An organic polymer according to any one of claims 19 to 22 wherein the third monomer comprises a group having a formula as shown in Formula VIII:



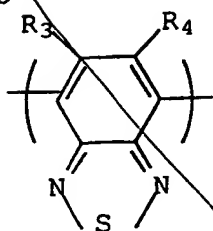
(VIII)

wherein  $X'$  is  $RC=CR$  or  $S$  and  $R_1$  and  $R_2$  are the same or different and are each a substituent group.

24. An organic polymer according to any one of claims 19 or 22, wherein the third monomer comprises a group having a formula as shown in Formula XI:

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Sub 177



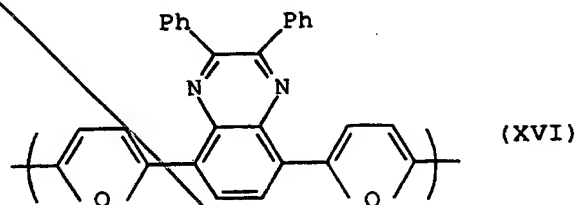
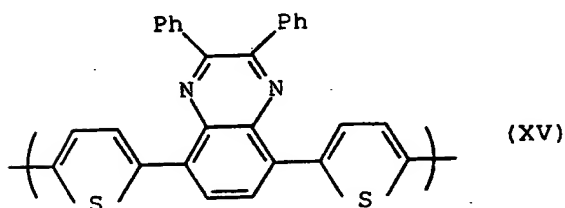
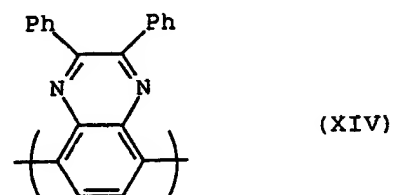
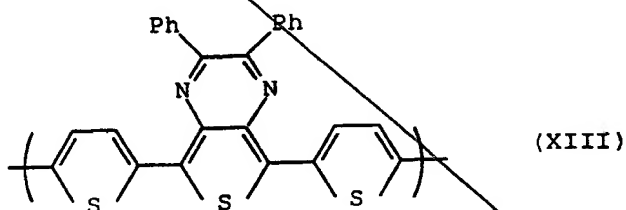
(XI)

wherein  $R_3$  and  $R_4$  are the same or different and are each independently a substituent group.

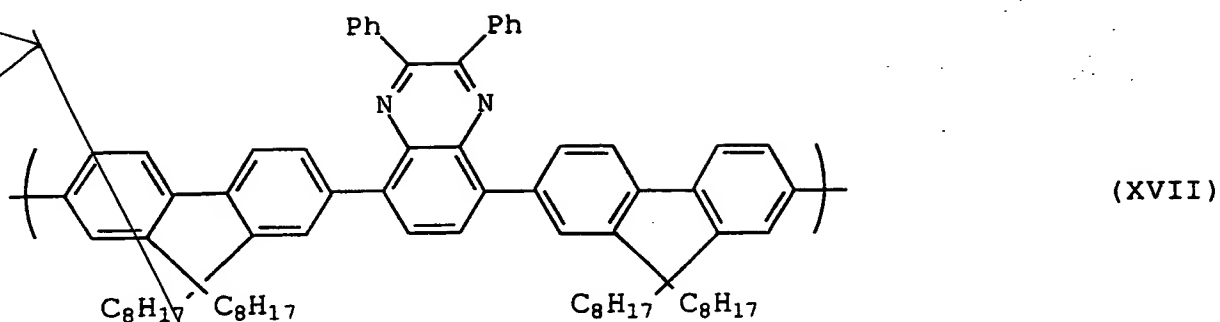
25. An organic polymer according to claim 23 or 24, wherein one or more of  $R_1$ ,  $R_2$ ,  $R_3$  and  $R_4$  is each independently selected from hydrogen, alkyl, aryl, perfluoroalkyl, thioalkyl, cyano, alkoxy, heteroaryl, alkylaryl, arylalkyl, pyridine or furan.

26. An organic polymer according to claim 25, wherein  $R_1$  and  $R_2$  or  $R_3$  and  $R_4$  are the same and are each a phenyl group.

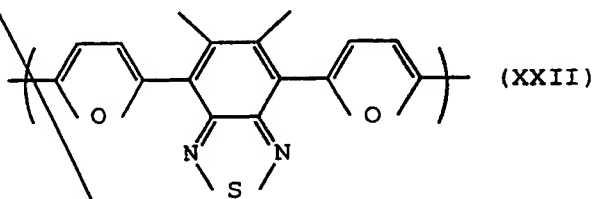
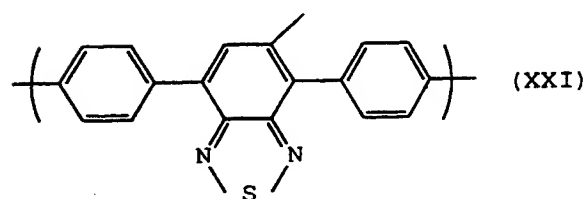
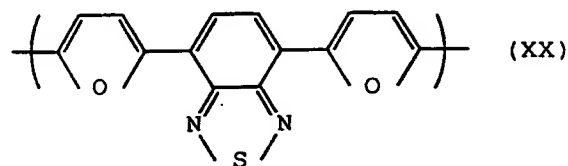
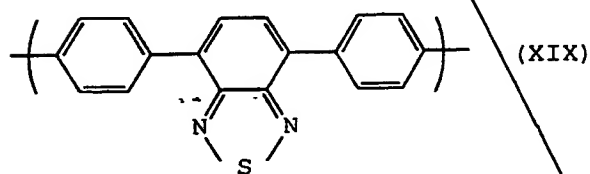
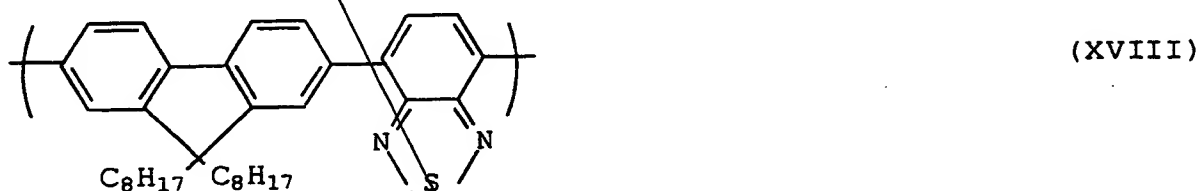
27. An organic polymer according to any one of claims 23, 25 or 26, wherein the third monomer comprises a group having a formula as shown in any one of Formulas XIII to XVII:



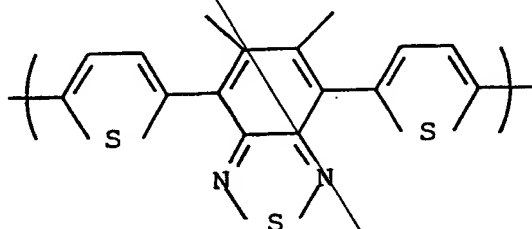
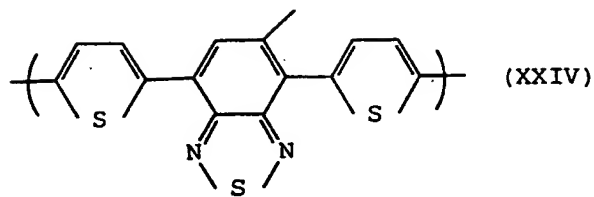
Sub A8  
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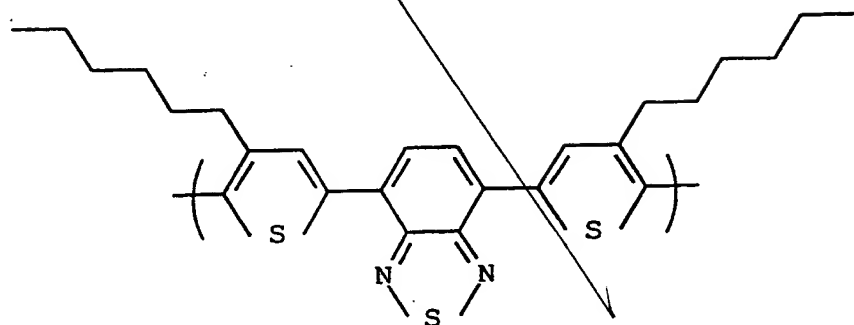
28. An organic polymer according to any one of claims 23 to 26, wherein the third monomer comprises a group having a formula as shown in any one of Formulas XVIII to XXVI:



(XXIII)



( XXV )



(XXVI)

29. An organic polymer according to claim 18, wherein the third monomer comprises a triarylamine unit.
30. An organic polymer according to claim 29, wherein the third monomer comprises a group having the formula  $\text{[-Ar}_2\text{N-)-Ar-(-NAr}_2\text{-)]}$ , wherein each Ar is the same or different and comprises a substituted or unsubstituted aromatic or heteroaromatic group.
31. An organic polymer according to claim 30, wherein at least one Ar comprises a substituted or unsubstituted aryl group.
32. An organic polymer according to claim 31, wherein the at least one Ar comprises an unsubstituted phenyl group.



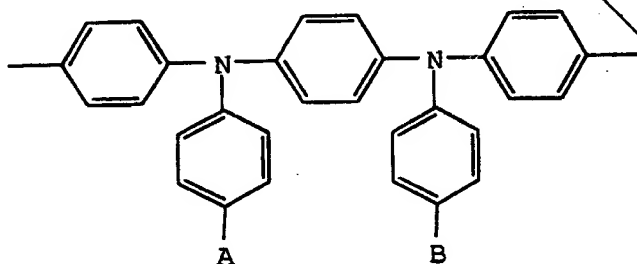
Sub A9  
33. An organic polymer according to any one of claims 30 to 32, wherein at least one Ar comprises a substituted or unsubstituted aromatic or heteroaromatic side group that is pendent to the polymer backbone.

34. An organic polymer according to claim 33, wherein the side group comprises fused or unfused benzene, thiophene, furan, quinoxaline, biphenyl or fluorene group.

35. An organic polymer according to claim 34, wherein the side group comprises a monosubstituted phenyl group.

Sub A10  
36. An organic polymer according to any one of claims 33 to 35, wherein the side group has a substituent group comprising hydrogen or a substituted or unsubstituted alkyl, perfluoroalkyl, alkylaryl, arylalkyl, heteroaryl, aryl, alkoxy, thioalkyl or cyano group.

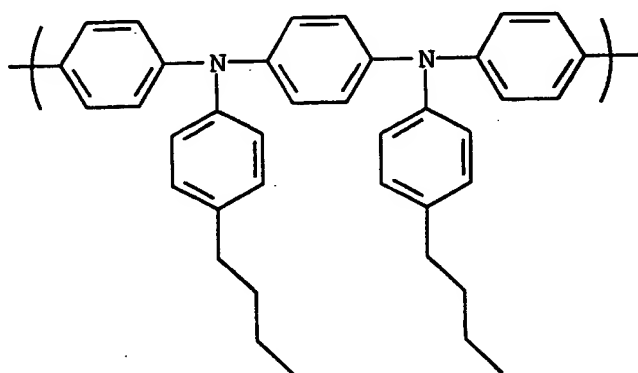
37. An organic polymer according to claim 35 or 36, wherein the triarylamine unit comprises a group having a formula as shown in Formula IV



(IV)

wherein A and B are the same or different and are substituent groups.

38. An organic polymer according to claim 37, wherein the third monomer comprises a group having a formula as shown in Formula XXVII:



(XXVII)

39. An organic polymer according to any one of claims 1 to 38, wherein the first region additionally comprises a fourth monomer comprising a further substituted or unsubstituted aromatic or heteroaromatic group.

40. An organic polymer according to claim 39 wherein the further substituted or unsubstituted aromatic or heteroaromatic group comprises a group as shown in formula XI wherein  $R_3$  and  $R_4$  are both hydrogen.

41. An organic polymer according to any one of claims 6 to 40, wherein the second region additionally comprises a fifth monomer comprising a further second monomer as defined in any one of claims 6 to 17, which is different from the second monomer.

42. An organic polymer according to any one of the preceding claims, comprising:

- (i) a first region for transporting negative charge carriers and having a first bandgap defined by a first LUMO level and a first HOMO level;

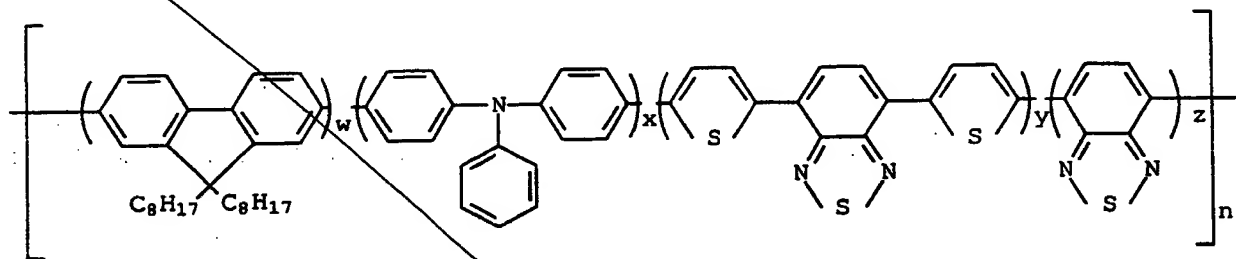
Sub A12  
cont.  
(ii) a second region for transporting positive charge carriers and having a second bandgap defined by a second LUMO level and a second HOMO level; and

(iii) a third region for accepting and combining positive and negative charge carriers to generate light and having a third bandgap defined by a third LUMO level and a third HOMO level,

wherein each region comprises one or more monomers and the quantity and arrangement of the monomers in the organic polymer is selected so that the first, second and third bandgaps are distinct from one another in the polymer.

43. An organic polymer according to claim 42, wherein the third region is capable of generating light with a wavelength in the range 600 nm to 700 nm

Sub B  
44 An organic polymer according to claim 42 or 43 having a formula as shown in Formula XXVIII:

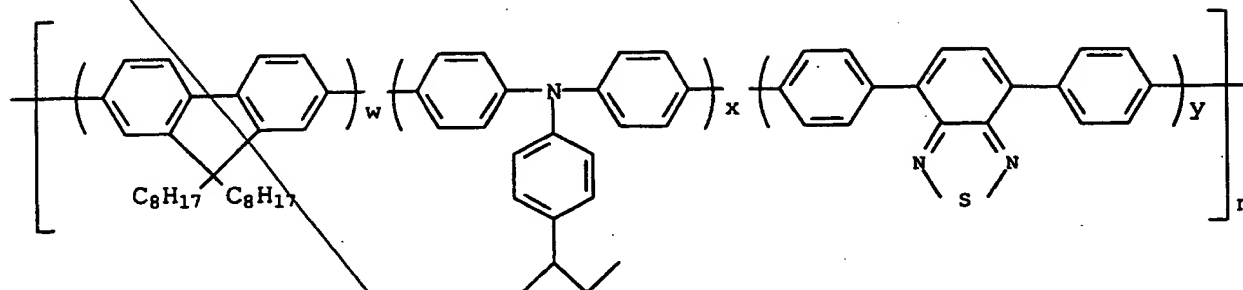


XXVIII

wherein  $w + x + y + z = 1$ ,  $w \geq 0.5$ ,  $0 \leq x + y + z \leq 0.5$  and  $n \geq z$ .

Sub B  
45. An organic polymer according to claim 42, wherein the third monomer is capable of generating light having a wavelength in the range 500 nm to 600 nm

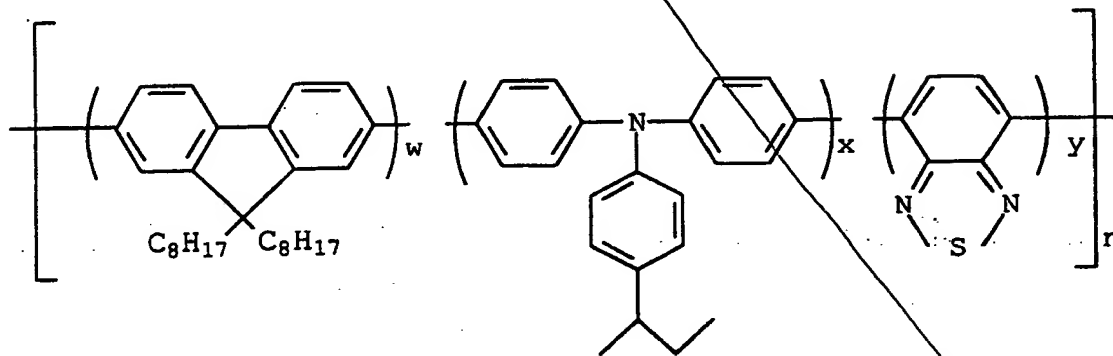
- Sub A14  
46. An organic polymer according to claim 42 or 45, having a formula as shown in Formula XXIX:



(XXIX)

wherein  $w + x + y = 1$ ,  $w \geq 0.5$ ,  $0 \leq x + y \leq 0.5$  and  $n \geq 2$ .

47. An organic polymer according to claim 42 or 45, having a formula as shown in Formula XXX:

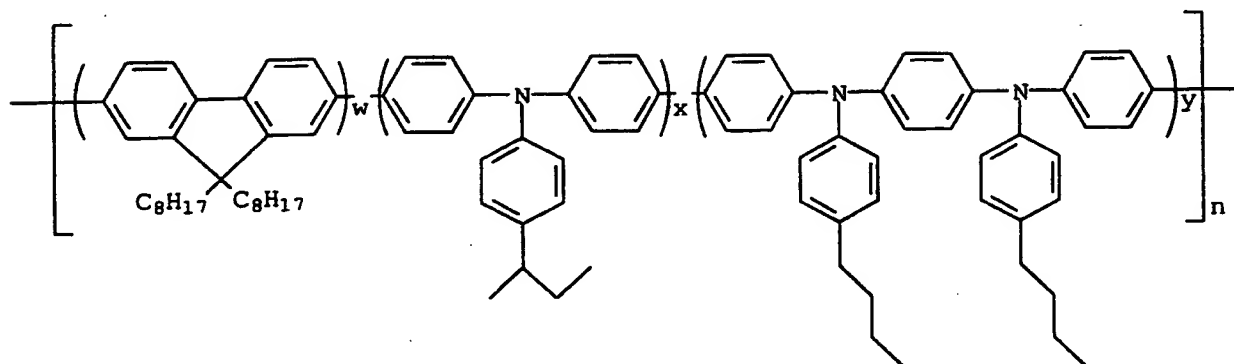


(XXX)

wherein  $w + x + y = 1$ ,  $w \geq 0.5$ ,  $0 \leq x + y \leq 0.5$  and  $n \geq 2$ .

- Sub 26  
48. An organic polymer according to claim 42, wherein the third monomer is capable of generating light having a wavelength in the range 400 nm to 500 nm.

49. An organic polymer according to claim 51, having a formula as shown in Formula XXXI:



(XXXI)

wherein  $w + x + y = 1$ ,  $w \geq 0.5$ ,  $0 \leq x + y \leq 0.5$  and  $n \geq 2$ .

50. An organic polymer according to any one claims 1 to 41, comprising:

(i) a first region for transporting negative charge carriers and having a first bandgap defined by a first LUMO level and a first HOMO level; and

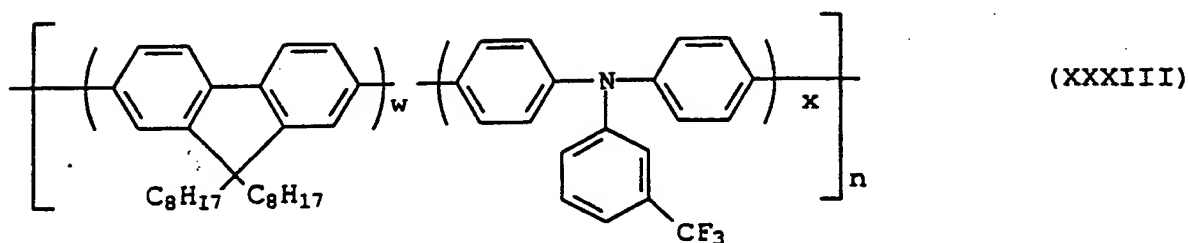
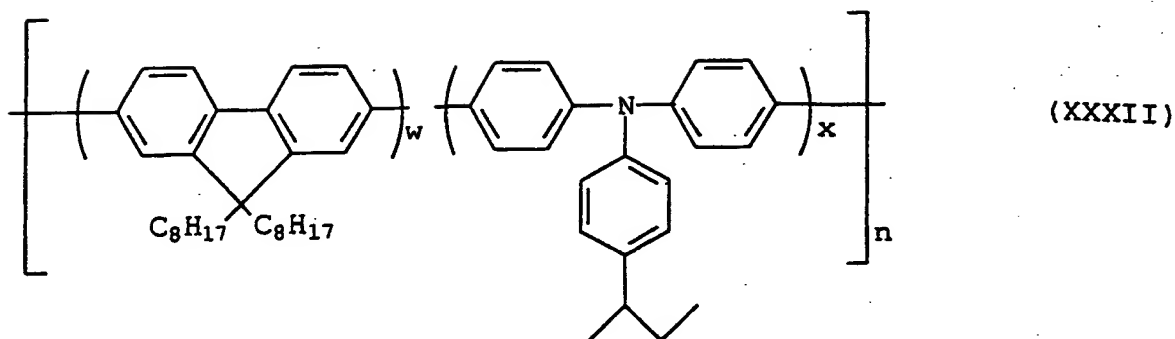
(ii) a second region for transporting positive charge carriers and having a second bandgap defined by a second LUMO level and a second HOMO level; and

wherein each region comprises one or more monomers and the quantity and arrangement of the monomers within the organic polymer is selected so that the first and second bandgaps are distinct from one another in the polymer.

51. An organic polymer according to claim 50, having a formula as shown in Formula XXXII or XXXIII:

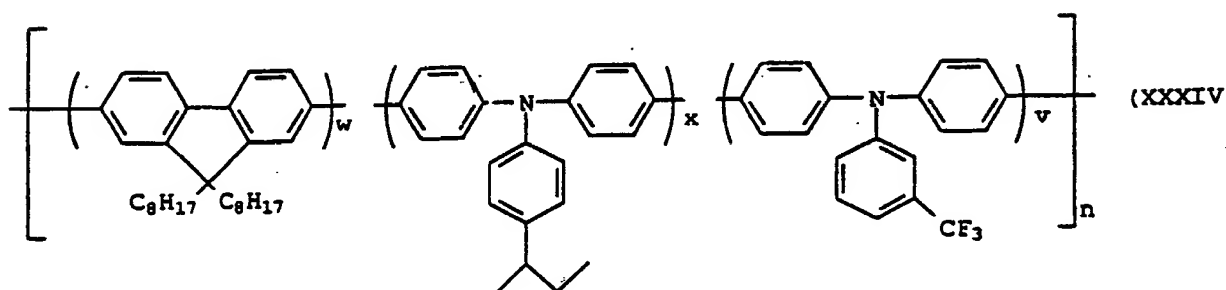
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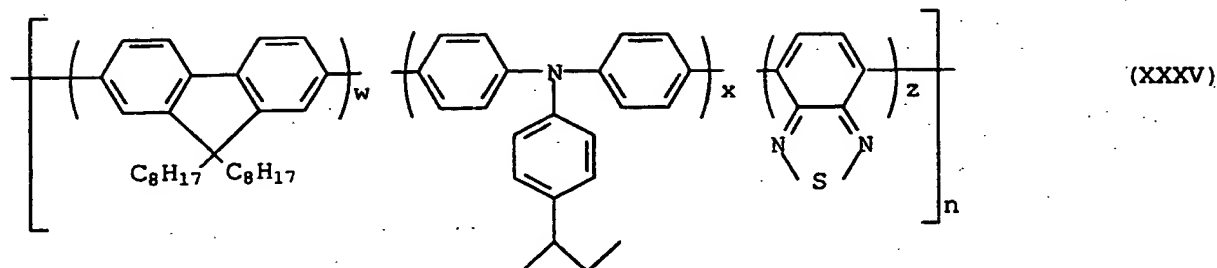
wherein  $w + x = 1$ ,  $w \geq 0.5$ ,  $x \leq 0.5$  and  $n \geq 2$ .

52. An organic polymer according to claim 50, having a formula as shown in Formula XXXIV:



wherein  $w + x + v = 1$ ,  $w \geq 0.5$ ,  $0 \leq x + v \leq 0.5$  and  $n \geq 2$ .

53. An organic polymer according to claim 50, having a formula as shown in Formula XXXV:



wherein  $w + x + z = 1$ ,  $w \geq 0.5$ ,  $0 \leq x + z \leq 0.5$  and  $n \geq 2$ .

54. An organic polymer according to any one of claims 50 to 53, which is blended with a light emissive material.

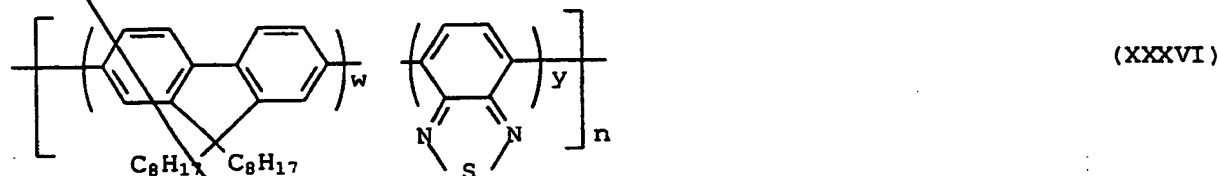
55. An organic polymer according to any one of claims 1 to 41, comprising:

(i) a first region for transporting negative charge carriers and having a first bandgap defined by a first LUMO level and a first HOMO level; and

(ii) a third region for accepting and combining positive and negative charge carriers to generate light and having a third bandgap defined by a third LUMO level and a third HOMO level,

wherein each region comprises one or more monomers and the quantity and arrangement of the monomers in the organic polymer is selected so that the first and third bandgaps are distinct from one another in the polymer.

56. An organic polymer according to claim 65, having a formula as shown in Formula XXXVI:



wherein  $w + y = 1$ ,  $w \geq 0.5$  and  $y \leq 0.5$  and  $n \geq 2$ .

Sub A17  
57. An organic polymer according to claim 55 or 56, which is blended with a hole-transporting material.

58. An organic polymer according to claim 57, wherein the hole transporting material comprises a poly-triarylamine.

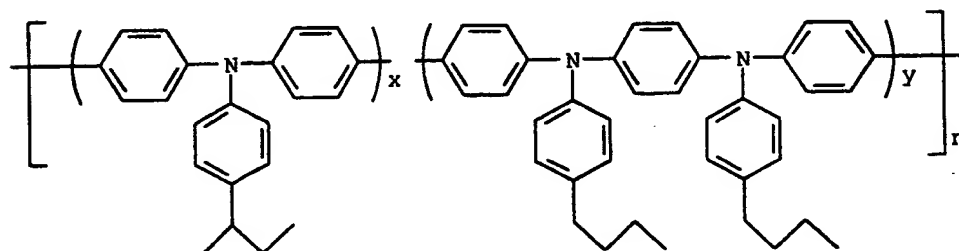
Sub A18  
59. An organic polymer according to any one of claims 1 to 41, comprising:

(i) a second region for transporting positive charge carriers and having a second bandgap defined by a second LUMO level and a second HOMO level; and

(ii) a third region for accepting and combining positive and negative charge carriers to generate light and having a third bandgap defined by a third LUMO level and a third HOMO level,

wherein each region comprises one or more monomers and the quantity and arrangement of the monomers in the organic polymer is selected so that the second and third bandgaps are distinct from one another in the polymer.

60. An organic polymer according to claim 59, having a formula as shown in Formula XXXVII:



(XXXVII)



- 55 -

wherein  $x + y = 1$ ,  $x \geq 0.5$  and  $y \leq 0.5$  and  $n \geq 2$ .

Sub A19  
61. An organic polymer according to claim 59 or 60 which is blended with an electron transporting material.

62. An organic polymer according to claim 61, wherein the electron transporting material comprises poly-fluorene.

Sub A20  
63. Use of a polymer according to any of the preceding claims in an optical device.

64. Use according to claim 63, wherein the optical device comprises an electroluminescent device.

65. An electroluminescent device comprising an anode layer, a cathode layer and a layer of a polymer according to any one of claims 1 to 62 situated between the anode layer and the cathode layer.

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